***E4732 CaseStudy 4 name: Yunfei Yan UNI: yy2516***

*(1) Description of coding environment.*

*I use Mobaxterm to code this case study 4 @clic-lab.cs.columbia.edu in linux environment, my compiler is clang++ and my editor is vim.*

*I use the following libraries to do the calculation:*

*#include<cstdio>*

*#include<cstdlib>*

*#include<cstring>*

*#include<cmath>*

*#include<iostream>*

*#include<ctime>*

*#include<gsl/gsl\_multimin.h>*

*#include<algorithm>*

*(2) My answers to the question:*

*According to the pseudo code the Professor Ali gave to us, I realized it in C++. Details are listed as follows:*

*1.*

*I didn’t use the matrix as data type for F,U,Q,P,P1,H,K,X,X1. Instead, I put all the data in an array, and treat these arrays as the pseudo-matrixes.*

**

*2.*

*During the estimation process, I have encountered that sometimes, A would be very small which lead logA approaches the negative limit. So, I have added the following condition to make sure the success of our method:*

*If ( A == A )*

*{*

*Likelihood += log ( A ) + e \* e / A;*

*}*

*3.*

*Since we require that volatility could not be negative, we have the following condition to make sure it:*

**

*What’s more, we also require that these parameters: theta, kappa, v0, and sigma should be positive:*

**

*So, we have the following penalty functions:*

**

*4.*

*My results are listed as below:*

|  |  |  |
| --- | --- | --- |
| *Heston* | *A* | *B* |
| *mu* | *0.0125* | *0.01* |
| *sigma* | *0.3353* | *0.3* |
| *kappa* | *1.4440* | *2.5* |
| *theta* | *0.0184* | *0.02* |
| *rho* | *-0.5267* | *-0.5* |
| *v0* | *0.0225* | *0.02* |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *steps* | *step* | *mu* | *sigma* | *kappa* | *theta* | *rho* | *v0* | *condition* | *dataset* | *time(seconds)* | *convergence value* |
| *366* | *1* | *-0.1125* | *0.194919* | *1.300037* | *0.014612* | *-0.390362* | *0.008905* | *2.42E-08* | *A* | *0.08s* | *-14859.007* |
| *214* | *2* | *0.051938* | *0.275636* | *3.602866* | *0.010544* | *-0.455557* | *0.011362* | *1.06E-06* | *A* | *0.14s* | *-14685.285* |
| *408* | *1* | *-0.12268* | *0.3156* | *2.75069* | *0.018105* | *-0.428197* | *0.010591* | *4.69E-11* | *B* | *0.17s* | *-14746.221* |

*(3) Description of the logic present in the written source code:*

*In heston.cpp, I have written the following functions listed below:*

*pricereading: for reading the data*

*myparameter: a function to get the objective function value*

*main:*

*I download my code from Mobaxterm directly with .cpp type. You can open it using notepad ( I have already tried, and it works. ) If you cannot open it, please contact me.*

*Thank you!*